

INTRODUCTION

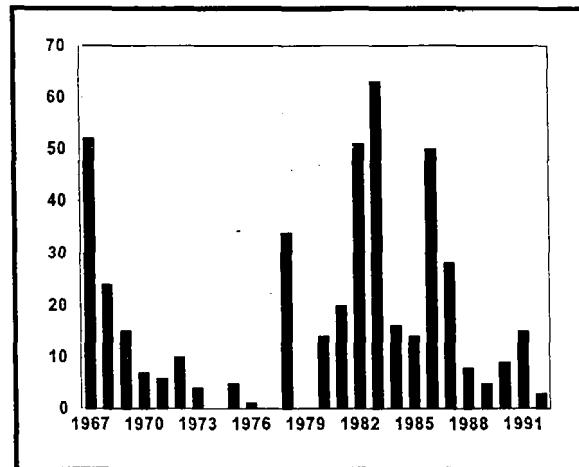
The splittail is a native resident fish of the lower reaches of the Sacramento and San Joaquin rivers. It has been listed under the federal Endangered Species Act and is a candidate for listing under the California Endangered Species Act. The splittail supports a small winter sport fishery in the lower Sacramento River.

Major factors that limit its contribution to the health of the Bay-Delta include loss of floodplain spawning and rearing habitat, and low streamflows that limit floodplain inundation and transport young to downstream nursery areas. Recent information suggests that losses to water diversions do not have an important effect on the population (Sommer et al. 1997).

RESOURCE DESCRIPTION

Splittail are endemic to the Sacramento-San Joaquin Delta estuary and to the lower reaches of the Sacramento and San Joaquin rivers. Splittail represent an important component of the historical native fish fauna. Splittail tolerate a wide range of salinity, but are most abundant in shallow areas where salinity is less than 10 parts per thousand (ppt). Spawning occurs in fresh water, primarily in floodplain areas upstream of the Delta including the Mokelumne, Feather and American rivers, and downstream of the Delta in the Napa and Petaluma rivers (Sommer et al. 1997). Spawning habitat includes shallow edgewater and seasonally flooded riparian zones and flood bypass areas that provide spawning substrate (e.g., submerged vegetation). Rearing habitat includes shallow- fresh- and brackish water (less than 10 ppt salinity) habitat that provide a protective, food-rich environment.

The population abundance of splittail is highly variable. Year-class abundance varies greatly. Low year-class success occurred throughout the 1987-1992 drought years. Age-0 abundance declined in the estuary during the 6 year drought and typically declines in dry years (Sommer et al. 1997).

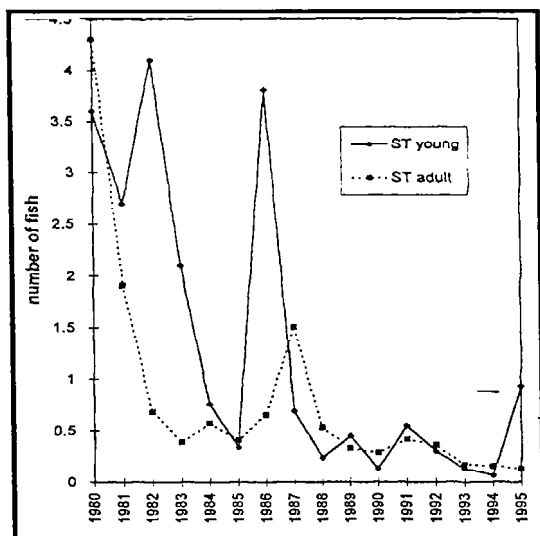


Abundance Data for Splittail from DFG Fall Mid Water Trawl Survey (USFWS 1996)

Floodplain inundation is a significant element required to maintain strong year classes (Sommer et al. 1997). Access to habitat throughout the geographic range of splittail has been greatly diminished by human-caused actions. Restrictions to the floodplain, loss of marshes, and reduced winter-spring river flows from flood control and water supply development have reduced the species' range and abundance. In addition, water quality (e.g., high temperature and dissolved solids) reduce the use of the lower San Joaquin River by splittail.

Splittail have limited productivity particularly in periods of drought, primarily from low freshwater inflow to the Bay-Delta and modification of habitat by past and ongoing human actions. Dams and levees restrict access to historical, seasonally flooded spawning and rearing habitat. Abundant year classes are generally associated with winter and spring flows sufficient to flood peripheral areas of the Delta and lower river reaches, including the flood bypass system of the Sacramento River and the floodplain of the San Joaquin River. Flood control reservoirs reduce

flooding in the Sacramento, San Joaquin, American, Feather, Mokelumne, Stanislaus, Tuolumne, Merced, and Calaveras rivers.



Index of Adult and Juvenile Splittail
in Suisun Marsh Trawl Survey

Levee construction in the 1800s created narrow channels and eliminated vast areas of fluvial marsh and seasonal wetlands that are important as spawning and rearing habitat for splittail.

Food availability, toxic substances, and competition and predation (particularly from striped bass and other introduced species) are among the factors limiting splittail abundance. In addition, harvest for food and bait by sport anglers may inhibit recovery of the splittail population.



VISION

The vision for splittail is to recover this federally listed threatened species in order to contribute to the overall species richness and diversity and to reduce conflict between protection for this species and other beneficial uses of water in the Bay-Delta.

Splittail would benefit from improvements in spawning and rearing habitat, and late winter and spring river flows. Increases in the frequency of floodplain inundation, improved access to floodplain areas, and increased freshwater flows would contribute most to their recovery. Additional freshwater flow could be provided during late winter

and spring to inundate floodplains and attract adults to upstream spawning areas, transport young to downstream nursery areas in the Bay-Delta, and maintain low salinity habitat in the western Delta and Suisun Bay.

Restoring splittail will require restoring seasonally flooded spawning and rearing habitat. Habitat restoration may be achieved by adding and modifying physical habitat and additional freshwater flow during critical periods. Actions include breaching levees to inundate existing islands, setting levees back to increase shallow-water habitat along existing channels, protecting existing shallow-water habitat from erosion, and filling deep water areas with sediments to create shallow-water habitat.

Splittail have a high fecundity which, when combined with years of high flows, allows the population to benefit from high recruitment rates.

SPECIES RECOVERY

The objective is to recover splittail without causing adverse impact to other listed species. Splittail will be considered out of danger when their population dynamics and distribution patterns within the estuary are similar to those that existed from 1967-1983. This period was chosen because it includes the earliest continuous data on splittail abundances and was a period when splittail populations remained reasonably high in most years within the estuary (U.S. Fish and Wildlife Service 1996).

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Efforts to restore splittail would involve cooperation and support from other established programs that are protecting and improving conditions for delta smelt, striped bass, and other species.

- Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (U.S. Fish and Wildlife Service 1996) will be considered in developing program actions.
- Central Valley Project Improvement Act (CVPIA) will implement actions that will benefit splittail, including changing timing of diversion, restoring habitat, and dedicating flow during critical periods for co-occurring species.

- State Water Resources Control Board (SWRCB) will implement the Water Quality Control Plan for the San Francisco/Sacramento-San Joaquin Delta estuary, which includes provisions to limit entrainment in diversions and protect habitat conditions for splittail, chinook salmon, striped bass, and other species.

LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

Successful restoration of splittail will be closely tied with improving freshwater inflow, improved access to floodplain spawning and rearing habitats, floodplain inundation, and wetland restoration. Restoration actions are similar to those prescribed for other-native resident fishes including delta smelt.

OBJECTIVES, TARGETS ACTIONS, AND MEASURES



The Strategic Objective is to achieve, first, recovery and then large self-sustaining populations of at-risk native species dependent on the Delta, Suisun Bay and Suisun Marsh.

SPECIES TARGET: Species recovery objectives will be achieved when 2 of the following 3 criteria are met in at least 4 of every 5 years for a 15-year period: 1) the fall mid-water trawl survey numbers must be 19 or greater for 7 of 15 years, 2) Suisun Marsh catch per trawl must be 3.8 or greater and the catch of young-of-year must exceed 3.1 per trawl for 3 of 15 years, and 3) Bay Study otter trawls must be 18 or greater AND catch of young-of-year must exceed 14 for 3 out of 15 years.

LONG-TERM OBJECTIVE: Restore the splittail so that it is one of the most abundant fish species in the Sacramento-San Joaquin estuary and its tributaries.

SHORT-TERM OBJECTIVE: Achieve the recovery goals for splittail identified in the Delta Native Fishes Recovery Plan.

RATIONALE: The splittail was once widespread in lowland waters of the Central Valley but is today largely confined to the estuary, except during wet years. The splittail population dropped to a low point

in the estuary during the drought of the 1980s but rebounded to high levels in the estuary during wet years of the 1990s. It is likely that reproductive success of this species is tied to the timing and duration of flooding of the Yolo and Sutter Bypasses and to flooding of riparian zones along the major rivers of the Central Valley, so a return to its former abundance and distribution will require special management of these areas.

STAGE 1 EXPECTATIONS: At least one additional strong year class should have developed to maintain splittail populations, while factors limiting splittail spawning and recruitment success are determined and accounted for in a management plan.

RESTORATION ACTIONS

The targets for splittail include achieving a fall mid-water trawl index consistently of 20 units or higher, and a Suisun Marsh trawl index consistently of 4 units or higher.

The following general actions would assist in the recovery of splittail:

- improve late winter and spring freshwater flows,
- increase flooded and shallow water spawning habitat in rivers and Bay-Delta,
- reduce pollutant input to streams and rivers in the Sacramento-San Joaquin River basin,
- prevent introduction of non-native species,
- High water temperatures and dissolved solids also reduce splittail use of the lower San Joaquin River.

MSCS CONSERVATION MEASURES

The following conservation measures are included in the Multi-Species Conservation Strategy (2000) which provide additional detail to ERP actions that would help achieve splittail habitat or population targets.

- Coordinate protection, enhancement, and restoration of occupied and historic Sacramento splittail habitats with other federal, state, and regional programs (e.g., the San Francisco Bay Area Wetlands Ecosystem Goals Project, the

Anadromous Fish Restoration Program, the U.S. Fish and Wildlife Service recovery plans, the SB 1086 program, and the Corps' Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historic habitat use areas to avoid potential conflicts among management objectives and identify opportunities for achieving multiple management objectives.

- To the extent consistent with CALFED objectives, remove diversion dams that block splittail access to lower floodplain river spawning areas.
- Minimize changes in the timing and volume of freshwater flows in the rivers to the Bay-Delta.
- To the extent consistent with CALFED objectives, direct ERP actions towards setting back levees in the south Delta to increase shallow water habitat.
- To the extent consistent with CALFED objectives, reduce the extent of reversed flows in the lower San Joaquin and Delta during the period from February through June.
- Reduce loss of splittail at south Delta pumping plants from predation and salvage handling and transport.
- Reduce the loss of young splittail to entrainment into south Delta pumping plants.
- To the extent practicable, reduce the loss of splittail at 1,800 unscreened diversions in the Delta.
- Reduce losses of adult splittail spawners during their upstream migration to recreational fishery harvest.
- To the extent consistent with CALFED objectives, improve Delta water quality particularly in dry years when pesticide levels and total dissolved solids are high.
- To the extent consistent with CALFED objectives, reduce the concentrations of pollutants in the Colusa Basin Drain and other agricultural drains into the Bay-Delta and its watershed.

- Modify operation of the Delta Cross Channel to minimize potential to increase exposure of splittail population in the Delta to the south Delta pumping plants.
- Modify operation of the barrier at the Head of Old River to minimize the potential for drawing splittail toward the south Delta pumping plants.
- To the extent practicable, design and construct overflow basins from existing leveed lands in stages using construction design and operating schemes and procedures developed through pilot studies and project experience to minimize the potential for stranding as waters recede from overflow areas.
- Consistent with CALFED objectives, design modifications to South Delta channels to improve circulation and transport of north of Delta water to the south Delta pumping plants to ensure habitat supports splittail and not to increase transport of splittail to the south Delta pumping plants.
- To the extent practicable design seasonal wetlands that have hydrological connectivity with occupied channels to reduce the likelihood for stranding and to provide the structural conditions necessary for spawning.
- To the extent consistent with CALFED objectives, protect spawning areas by providing suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emerged and submerged vegetation).
- Avoid or minimize adverse effects on rearing habitat from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions, in-channel barriers, or tidal gates).
- To the extent consistent with CALFED objectives, maintain a low salinity zone in historical occupied habitat areas of the Bay and Delta from February 1 through August 31.
- To the extent consistent with CALFED objectives, provide unrestricted access of adults to spawning habitat from December to July by

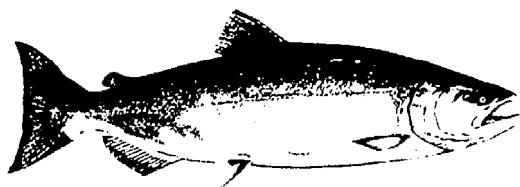
maintaining adequate flow and water quality, and minimizing disturbance and flow disruption.

- Expand the IEP monitoring efforts in the south Delta for Sacramento splittail.
- To the extent consistent with CALFED objectives, initiate implementation of the U.S. Fish and Wildlife Service's "Rainbow Report" or similar documentation to provide increased water quality in the south Delta and eliminate or reduce the need for installation of barriers.
- To the extent consistent with CALFED objectives, reduce the effects on splittail from changes in reservoir operations and ramping rates for flood control.
- To the extent consistent with CALFED objectives, reduce the loss of freshwater and low-salinity splittail habitat in the Bay-Delta as a result of reductions in Delta inflow and outflow.
- Consistent with CALFED objectives, increase the frequency of flood bypass flooding in non-wet years to improve splittail spawning and early rearing habitat.
- To the extent consistent with CALFED objectives, ensure that the Yolo and Sutter Bypasses are flooded during the spawning season at least once every 5 years.
- To the extent consistent with CALFED objectives, improve the frequency, duration, and extent of bypass flooding in all years.
- Develop a water management plan to allocated multiyear water supply in reservoirs to protect drought year supplies and sources of winter-spring Delta inflow and outflow needed to sustain splittail and their habitat.

REFERENCES

- Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.
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◆ CHINOOK SALMON



INTRODUCTION

Chinook salmon are medium- to large-bodied fish that spawn in freshwater, migrate to the ocean as juveniles, achieve significant growth, and return to freshwater at varying degrees of sexual maturity. Four runs of chinook salmon are present in the Central Valley, distinguished by their timing of reentry to fresh water: fall, late-fall, winter, and spring (Boydstrun et al. 1992). Winter-run chinook salmon were formally listed as an endangered species under the California Endangered Species Act (CESA) in 1989, and as endangered under the federal Endangered Species Act (ESA) in 1994 (National Marine Fisheries Service [NMFS] 1997). Spring-run were listed as a threatened species under CESA in 1998 and ESA in 1999. The NMFS has reviewed the status of the Central Valley fall-run chinook salmon ESU, including late-fall-run, and determined that listing is not warranted at this time, but will continue to consider it a candidate under the ESA.

Listing status of Central Valley chinook salmon populations.

Chinook Stock	Listing Status
Winter-run	Endangered - ESA Endangered - CESA
Spring-run	Threatened - ESA Threatened - CESA
Late-fall-run and Fall-run	Candidate - ESA

Listing of the winter-run chinook population reflected poor ecological health of the Bay-Delta watershed including the Sacramento River and placed

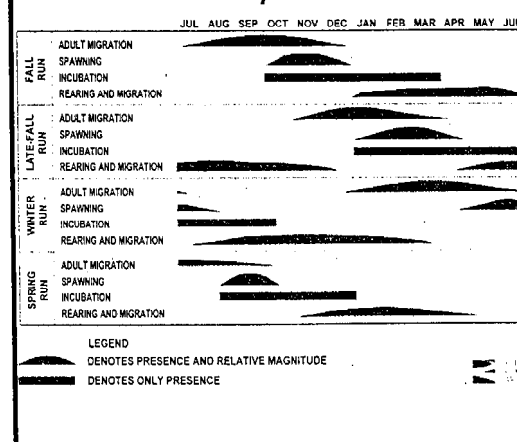
additional regulatory controls on water management operations in the Central Valley. Water management regulations for winter-run chinook salmon affect the magnitude of flow by season in the Sacramento River and the volume of carryover storage in Shasta Reservoir for temperature control in the upper Sacramento River. The regulations also constrain the timing of water diversions at various location in the Sacramento River.

The key to improving chinook salmon populations will be maintaining populations through periods of drought by improving streamflow magnitude, timing, and duration; reducing the effects of the CVP/SWP export pumps in the southern Delta which alter Delta hydrodynamics, juvenile rearing and migration patterns, and cause entrainment at the facilities; and reducing stressors such as unscreened water diversions, high water temperatures, and harvest of naturally spawned salmon.

RESOURCE DESCRIPTION

Chinook salmon represent a highly valued biological resource and a significant biological legacy in the Central Valley of California. Central Valley chinook salmon comprise numerous individual stocks, including the Sacramento fall-run, late-fall-run, spring-run, winter-run, and San Joaquin fall-run. The continued existence of Central Valley chinook salmon is closely linked to overall ecosystem integrity and health (Mills et al. 1996).

Life History Sacramento River
Chinook Salmon Upstream of Red Bluff



Because of their life cycle, typical of all Pacific salmon, Central Valley chinook salmon require high-quality habitats for migration, holding, spawning, egg incubation, emergence, rearing, and emigration to the ocean. These diverse habitats are still present throughout the Central Valley and are successfully maintained to varying degrees by existing ecological processes. Human-caused actions (stressors) have diminished the quality and accessibility of habitats used by chinook salmon. These habitats can be restored through a comprehensive program that strives to restore or reactivate ecological processes, functions, and habitat elements on a systematic basis. Recovery will require reducing or eliminating known sources of mortality and other stressors that impair the survival of chinook salmon. The restoration approach must fully consider the problems and opportunities within each individual watershed and must be fine-tuned to meet the requirements of locally adapted stocks.

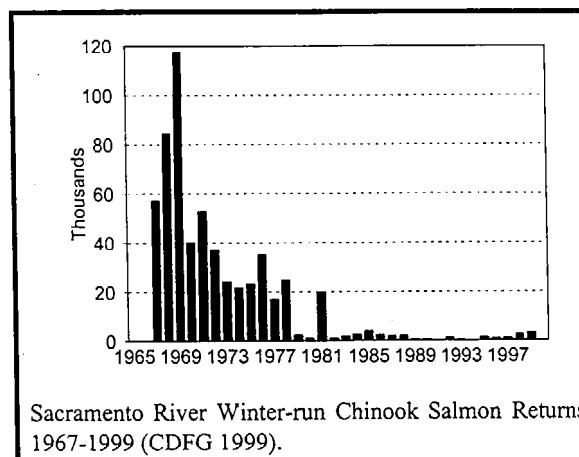
The National Marine Fisheries Service (1998), in its status review of west coast chinook stocks, identified major chinook groupings based on preliminary data regarding ecological, geographical, and genetic differences among chinook stocks. These major groups included the Sacramento River winter-run evolutionarily significant unit (ESU), Central Valley spring-run ESU, and the Central Valley fall-run ESU. The fall-run ESU includes Sacramento and San Joaquin fall-run chinook, and late-fall-run chinook.

SACRAMENTO RIVER WINTER-RUN ESU.

During the listing process for winter-run chinook, both the California Department of Fish and Game and NMFS cited a list of factors considered important to the decline of winter-run chinook. These include the loss of juveniles to entrainment at poorly or unscreened diversions and loss to the state and Federal water project pumps in the Delta. Impacts at other State and Federal water project facilities such as Red Bluff Diversion Dam, and Keswick and Shasta dam operation were considered major factors.

This ESU includes chinook salmon entering the Sacramento River from November to June, an entry pattern not shared with any other chinook population. Winter-run spawn from late-April to mid-August, with a peak in May and June. In general, winter-run exhibit an ocean-type life-history strategy, with smolts migrating to the ocean after five

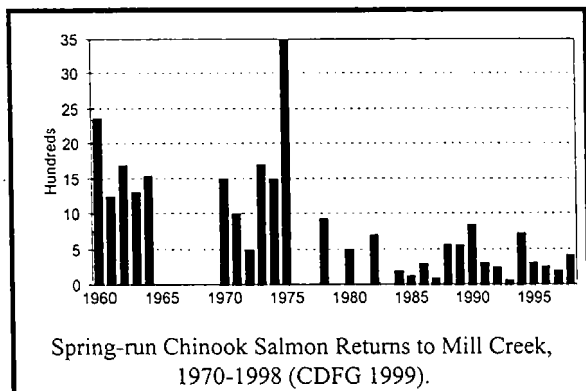
to nine months of residence in freshwater (Johnson et al. 1992). DNA analysis indicates substantial genetic differences between winter-run and other chinook salmon in the Sacramento River.



Historically, winter-run populations existed in the upper Sacramento, Pit, McCloud, and Calaveras rivers. There also are data that suggest winter-run inhabited Battle Creek prior to its development for hydropower production. Construction of dams on these rivers in the 1940s displaced the Sacramento River population to areas the main stem Sacramento River below Shasta Dam.

CENTRAL VALLEY SPRING-RUN ESU. Spring-run chinook were the dominant run in the Sacramento and San Joaquin river systems prior to the construction of dams and water development projects. Spring-run chinook have been eliminated from the San Joaquin Basin but are still present in some of the tributary streams of the Sacramento River. Mill, Deer, and Butte creeks consistently support spawning populations of spring-run chinook salmon. Several other tributaries occasionally have spring run present. These include Big Chico, Antelope, and Beegum creeks. There may be some spring run in the Feather River, but these fish have likely interbred with fall-run chinook. The status of spring-run chinook in the Yuba River is uncertain, but a small population may exist (California Department of Fish and Game 1998).

This ESU includes chinook salmon entering the Sacramento River from March to July and spawning

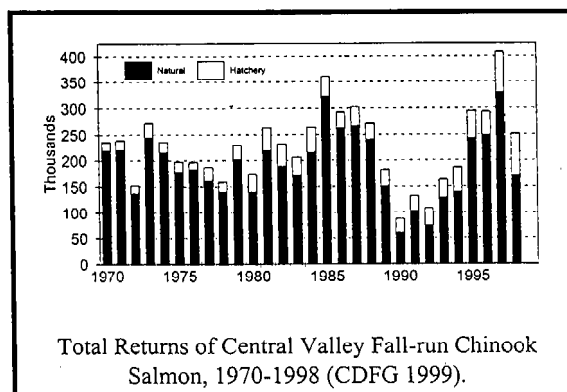
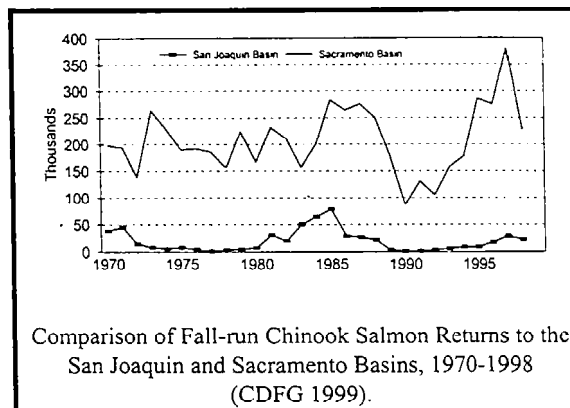
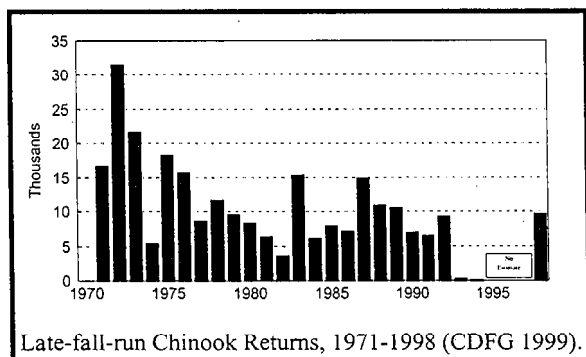


from late August through early October, with a peak of spawning in September. Spring-run chinook exhibit an ocean-type life history, and emigrate from their natal streams as fry, subyearlings, and yearlings (National Marine Fisheries Service 1998).

CENTRAL VALLEY FALL-RUN ESU. Fish in this ESU (fall-run and late-fall-run) enter freshwater from July through April and spawn from October through February. Both runs are ocean-type chinook, emigrating predominantly as fry and subyearlings.

Fall-run are the most abundant run in the Central Valley and populations are supported by an extensive State and Federal hatchery propagation program. Collectively, hatchery and naturally produced fall-run chinook maintain strong ocean sport and commercial troll fisheries as well as inland fisheries.

Overall, the abundances of stocks have varied annually since 1970 and exhibited depressions in adult returns during and following the 1976-1977 and 1987-1992 droughts (Mills and Fisher 1994). Low flows and reservoir storage levels during droughts caused high water temperatures, poor spawning and rearing habitat conditions, high predation rates, and high diversion losses, which in turn reduced salmon survival.



Chinook salmon are found in virtually all 14 ecological zones that comprise the ERP Study Area and many of their respective ecological units. Overall, the decline of the chinook salmon population resulted from the cumulative effects of degraded spawning, rearing, and migration habitats in the Sacramento and San Joaquin basins and the Sacramento-San Joaquin Delta. Specifically, the decline was most likely caused by a combination of factors that reduced or eliminated important ecological processes and functions, such as:

- excessively warm water temperatures during the prespawning, incubation, and early rearing periods of juvenile chinook;
- impaired or blocked passage of juveniles and adults at diversion and water storage dams;
- loss of natural emigration cues when flow regimes are altered as a result of the export of water from large diversions in the south Delta;
- heavy metal contamination from sources such as Iron Mountain Mine;

- entrainment at a large number of unscreened and poorly screened diversions; and
- degradation and loss of woody debris, shaded riverine aquatic (SRA) habitat, riparian corridors and forests, and floodplain functions and habitats from such factors such as channelization, levee construction, and land use.

Climatic events and human activity have exacerbated these habitat problems. Lengthy droughts have led to low flows and higher temperatures. Periodic El Niño conditions in the Pacific Ocean have reduced salmon survival by altering ocean current patterns. Ocean and inland recreational and commercial salmon fisheries have probably impaired efforts to rebuild salmon stocks.

Other human activities also have contributed to the decline of the chinook, although perhaps to a lesser degree. These activities include:

- construction and operation of various smaller water manipulation facilities and dams;
- levee construction and marshland reclamation causing extensive loss of rearing habitats in the lower Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta; and
- the introduction of predatory species.

Past regulatory efforts have not adequately maintained some chinook stocks as healthy populations. As a result, the winter-run population was protected under the State and federal ESAs to save it from extinction. The spring-run chinook salmon also was listed, but as threatened in recognition of substantial restoration efforts underway. Since the listing of winter-run chinook, some significant habitat improvements have been made to help preserve this and other chinook populations. These include improved water temperatures and flow management for spawning, incubation, and rearing; improved passage of juveniles and adults at diversions and dams on the upper Sacramento River; reduced diversions during periods when juveniles are most susceptible to entrainment; and the installation of positive-barrier fish screens on the larger water diversions along the Sacramento River. Additional measures that focus on reactivating or improving ecological processes and functions that create and maintain habitats will be

necessary for recovery of Central Valley chinook salmon.

Rebuilding chinook populations to a healthy state will require a coordinated approach to restoring ecosystem processes and functions, restoring habitat, reducing or eliminating stressors on a site-specific basis, and improving management and operation of the five salmon hatcheries in the Central Valley.



VISION

The vision for Central Valley chinook salmon is to recover all stocks presently listed or proposed for listing under the ESA and CESA, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that fully use existing and restored habitats.

This vision will contribute to the overall species diversity and richness of the Bay-Delta system and reduce conflict between protection for this species and other beneficial uses of water and land in the Central Valley.

This vision is consistent with restoring the Sacramento River winter-run and spring-run chinook salmon to levels that will allow them to be removed from the State and federal endangered species lists; increasing populations of other chinook stocks to levels that eliminate any future need for protection under ESA and CESA; and providing population levels for all chinook stocks that sustain recreational and commercial fisheries and other scientific, educational, and nonconsumptive use of these valuable resources.

Within the broad context of ecosystem restoration, chinook salmon will benefit from a wide variety of actions, many of which are being implemented for other ecological purposes or which are not specific to chinook salmon. For example, restoring riparian woodlands along the Sacramento River between Keswick Dam and Verona will focus on natural stream meander, flow, and natural revegetational/successional processes. These factors will be extremely important in providing SRA habitat, woody debris, and other necessary habitats required by food organisms and juvenile and adult salmon populations.

Another example is to reactivate tidal flows into fresh and brackish marshes. Reactivating the tidal exchange in marshes will increase the production of lower trophic organisms, thereby improving the foodweb. Reactivating tidal exchange will also substantially increase the complexity of nearshore habitats in the lower mainstem rivers, the Delta, and the Bay, which will be valuable habitats for juvenile salmon.

Operating the water storage and conveyance systems throughout the Central Valley for their potential ecological benefits can be one of the more important elements in restoring a wide spectrum of ecological resources, including chinook salmon.

Harvest management will play an important role in restoring healthy salmon populations. Harvest management recommendations focus on rebuilding naturally spawning stocks.

Ecological processes selected for restoration include those that create and maintain critical habitat elements. Lack of adequate corridors between upstream holding, spawning, and rearing habitat in certain tributary streams has impaired or reduced the reproductive potential of some stocks such as spring-run chinook salmon.

Unscreened diversions are widespread in the Central Valley and are a known source of mortality to chinook salmon.

Many action-oriented activities are underway in the Central Valley that will assist in achieving the vision for chinook salmon. Some are short-term actions and some are long-term evaluations. All are designed to eliminate stressors and improve ecological processes and habitats.

VIABLE SALMONID POPULATIONS AND RECOVERY

The National Marine Fisheries Service has introduced a new and robust approach to define the recovery of chinook salmon and steelhead stocks (National Marine Fisheries Service 2000). Although this approach is still in the draft stage, it will be finalized and adopted as an important planning tool to ensure the recovery of listed stocks. This "viable salmonid population (VSP)" approach is designed to provide an explicit framework to identify biological requirements

that will contribute to assessing management and conservation actions. The VSP introduces four sets of guidelines to determine a stock's viability.

- Population Size (viable and critical levels)
- Productivity
- Spatial Structure
- Diversity.

The VSP approach has numerous meaningful benefits for the ERP including a more accurate depiction of stock status, improved means to assess needed recovery actions, a method to evaluate completed recovery actions, a means by which to assess progress toward recovery, and a framework to organize or redefine existing recovery and management goals for chinook salmon.

The proposed MSCS species goal prescription for chinook salmon is presented later in this section, after many of the existing agency recovery goals and management objectives for chinook salmon are presented. In the longer-term, these existing goals and objectives will likely be modified to be in agreement with the VSP approach. None-the-less, legislative and congressional intent through state and federal law will continue to set certain types of management goals for chinook. The CVPIA, for example, requires the doubling of natural production of Central Valley chinook salmon over the average of 1967-1991. The VSP approach can encompass the goal of such congressional actions while promoting the recovery of listed species.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

There are three major programs to restore chinook salmon populations in the Central Valley.

- Central Valley Project Improvement Act: The Secretary of the Interior is required by the Central Valley Project Improvement Act to double the natural production of Central Valley anadromous fish stocks by 2002 (U.S. Fish and Wildlife Service 1997).
- Endangered Species Recovery Plan: The National Marine Fisheries Service is required under the federal ESA to develop and implement a recovery plan for the endangered winter-run chinook and